SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1463.—Vol. XXXIII.] LONDON, SATURDAY, SEPTEMBER 5, 1863. [WITH JOURNAL] STAMPED.... SIXPENCE. UNSTAMPED. FIVEPENCE.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

To attempt to give an abstract of the business done at a meeting of the British Association for the Advancement of Science would be out of the question, and more especially of a meeting in a district unusually interesting in a mining and industrial point of view. Almost every incident connected with the gathering is connected also with branches of industry in which our readers are interested, and no doubt many valuable papers are to be found amongst those to which no reference is made in the subjoined series of abstracts. With regard to those passed by, we can only say that we shall be glad to give insertion to any others which may be considered of general interest to our readers, upon being furnished by the authors with concise abstracts of their papers. In the Mathematical and Physical Science section the Abbe Moigno's demonstration of the invisibility of light is very curious, and the same may be said of the Dutch process of forecasting the weather, which proves that quite as much accuracy may be obtained by taking the mean of several barometers, and drawing general conclusions from comparison with former years, as by any other method. The papers in the Chemical Science section were, of course, interesting, the authors having the discoveries of aluminium, thallium, and a vast number of others, both new and important, to work upon. The Geological Science section was opened by an able address by Prof. W. Smyth, and in the papers of Mr. Nicholas Wood and Mr. Thomas Sopwith we have a really good sketch of the principal geological facts, of importance to commerce, connected with the district. The importance of Geology is pointed out in the inaugural address of the Zoological and Botanical section; and, when it is considered that to become a good geologist we must study the whole range of natural sciences, we think that it will be acknowledged that the science cannot be over-valued. In the Physiological sub-section Dr. Richardson's paper "On a Miner's Safety-mask, for Supporting Life in Fire-damp," will doubtless lead to good results; but with regard to Mr. Fawcett's paper, in the Economic Science and Statistics section, "On the Effects of the Recent Gold Discoveries," we are quite satisfied that there is no probability of the value of gold materially depreciating whilst the British Association continues to exist. From the time of Solomon gold has continually increased in value, and it will require something more than the Californian and Australian gold discoveries, or even the working of the Welsh gold mines, to produce an opposite movement. In the Mechanical Department perhaps the paper "On the Cutting of Coal by Machinery," by Mr. Firth, of the West Ardsley, is of the greatest interest, and which we hope to give *in extenso* upon another opportunity; though the Astronomer Royal's paper "On the Cause of Boiler Explosions" is of scarcely less value in a commercial point of view, and as a scientific contribution is absolutely invaluable.

Gun-Cotton.—In the Mathematical and Physical Sciences section, presided over by Prof. Macquorn Rankine, it was mentioned that, among the committees which were appointed by the Association at its former meeting, was one to investigate and report on the qualities of gun-cotton. The results of the labours of this committee were presented to the section. The committee had not had sufficient time to make any extensive experiments, and they had, therefore, confined themselves to giving a very complete account of the experiments made. From this report it appears that the Austrian gun-cotton exhibited a marked superiority over all other kinds of gun-cotton. Among its advantages were, that it did not become ignited till it was raised to a temperature of 136° centrigrade; that a gun was less injured by repeated discharges from it by gun-cotton than by gunpowder; that gun-cotton was not injured by damp like gunpowder; that no smoke arose from the explosion of the gun-cotton; and that there was no residuum left in the gun to be got rid of before another charge could be introduced.

Light Proved to be Invisible.—The Abbe Moigno exhibited and described M. Soleil's tenebroscope for showing the invisibility of light. The instrument consists of a long tube, closed at one end, but with a short opening in the centre, in which is introduced a white ivory ball, capable of being placed and withdrawn at pleasure. The object of the instrument is to illustrate the principle that light is only the action of the illuminiferous medium by which bodies are made visible; and that neither the light itself, or the medium, is visible. On looking through the glass with the ball withdrawn no light is seen, but immediately on the ball being replaced it is distinctly seen at the end of the tube.

Sulphate of Baryta from a Colliery.—Dr. Richardson made a brief communication to the effect that, in the year 1849, a spring of water made its appearance in the shaft of Walker Colliery, which Mr. Clarke, the mining engineer, carried off by means of a wooden pipe. The water was quite clear as it issued from the sides of the shaft, but it rapidly deposited a solid matter, which soon filled the pipes. This deposit contains a large quantity of sulphate of baryta, the analysis being—Sulphate of baryta, 90·01; sulphate of lime, 3·04; peroxide of iron, ·30; silica, 2·65; water, 3·51=99·51. After a time the deposit ceased to form, and he, unfortunately, had no opportunity of examining the water. The baryta most probably existed in the water in the form of hypo-sulphate of baryta, which, as the water fell down the pipe, absorbed oxygen from the air, and became converted into sulphate of baryta.—Prof. Miller said his attention had also been directed to the presence of the salt of baryta in a spring in the Hartley pit.

The Progress of Chemistry and the Chemical Arts.—This subject was ably treated by Professor A. W. Williamson, the President of the Chemical Science section, in his inaugural address. He referred to the rapid rate at which materials have been accumulating by the labours of chemists in the so-called organic departments of the science. The study of the transformation of organic bodies had led to the discoveries of new acids, new bases, new alcohols and ethers, at a constantly increasing rate, which was truly wonderful. Some of those new substances were found to possess properties which could at once be applied to practical purposes, such as dyeing, but most of them remained in their laboratories and museums, and served to teach new instances of the laws of combination. The science of chemistry had been simplified by every important addition to its materials. In the mineral, or inorganic departments of the science, there was not so much room for discovery; but it was not unworthy of remark, that even the heavy materials had of late years been found to combine with organic bodies in a number of most remarkable forms. The learned President proceeded to refer to the atomic theory, and remarked that every step in the theoretical development of chemistry had served to extend the atomic theory; but it was interesting to observe that the extension of that theory involved the necessity of depriving it of that absolute character which it once possessed, as organic bodies were discovered which contained their constituent elements in proportions not simple. Among the most brilliant and interesting experiments of mineral chemistry of late years, he must direct their attention to the introduction of the spectrum analysis, which had opened out an entirely new, and one of the most valuable, fields of investigation and research. It had not only led to the discovery of three entirely new metals, but it was also applied to analysing—if one might use the expression—the constituent elements of the heavenly bodies. Adverting next to the educational effects of the progress which had lately been made in chemistry, the President noticed the admission of chemistry and physics into the list of examinations for various Government appointments, both civil and military, and directed attention to the small value given to chemistry as compared with mathematical science, as shown by the small number of marks given to the former, so that the effect was to lead to the conclusion that the Government could not help acknowledging the experimental physical sciences, but that they wanted to encourage the study of them as little as possible. After alluding to the manner in which the University of London had encouraged the study of chemistry by the introduction of systematic degrees in recognition of physical science, Prof. Williamson said that the increasing importance attached to education in chemistry was mainly owing to the growing popular appreciation of the real value of chemical science, which would have the effect of gradually raising it to the prominent place in national education which it was destined to occupy. Noting next the progress of the chemical arts, the President referred to the improvements in furnaces, and to the recent improvements in the manufacture of iron. One of the most interesting novelties in metallurgy was the introduction of aluminium; and, in noticing this subject, he had great pleasure in referring to the extensive works of the distinguished Mayor of Newcastle (Mr. J. L. Bell, of Bell Brothers). The Professor concluded by pointing out the importance of the present application of chemistry to agriculture, and referring to the experiments made in connection with the utilisation of the drainage of towns, and to the recent discoveries of brilliant dyes from coal tar and other mineral products.

Smelting Cleveland Ironstone.—In a paper on a deposit found in the waste gas tubes in blast-furnaces smelting Cleveland ironstone, Mr. John Pattinson stated that a substance in fine powder, varying in colour from blackish grey to almost white, is deposited in the large tubes used for conveying the waste gases of iron smelting furnaces to the boiler and heating stoves, where they are economised. Some of the constituents of this deposit are doubtless volatilised by the intense heat of the furnaces, whilst others are merely carried over mechanically by the intense heat of the gases. In the waste gas tubes of the furnaces in which Cleveland ironstone is smelted this deposit accumulates in such quantity as to necessitate the cleaning out of the tubes every three or four months. It also adheres to the bottom of the boiler, and to the heating stove pipes, from which it has to be occasionally removed, as it materially prevents the conduction of heat. So far as he was aware, no analysis of the substance has yet been published. Samples selected for analysis were obtained from the waste gas tube of a furnace belonging to Messrs. Gilkes, Wilson, Pease, and Co., of Middlesbro'. In order to avoid as much as possible the presence of particles of dust carried over mechanically, the sample was taken from the underside of the tube at a point distant about 140 feet from the furnace. A mixture of Upleathan and Rosedale ironstone, with Weardale blue ironstone and South Durham cokes had been smelted in the furnace for some considerable time previous. The deposit was of a dark grey colour, and was in impalpably fine powder. On analysis it was found to contain—Protoxide of iron, 14·22; oxide of zinc, 10·48; sulphide of zinc, 13·70; alumina, 8·20; lime, 12·30; magnesia, 5·03; chloride of sodium, 5·74; ammonia, 0·70; thallium, trace; sulphuric acid, 3·18; free sulphur, 0·17; silicia, 22·60; carbonaceous matter, 4·50=99·84 per cent. The portion soluble in water had a slightly acid reaction, probably owing to sulphate of zinc, which was found to be present to the extent of 0·66 per cent. It also contained sulphate of lime, sulphate of ammonia, and chloride of sodium. A very small portion of the alumina and silica are dissolved by boiling with a solution of potash, from which fact, together with the acid reaction of the portion soluble in water, it is inferred that the most of the alumina, lime, and magnesia are in chemical combination with the silica. Sulphuretted hydrogen is copiously dissolved on the addition of hydrochloric acid, but not at all on the addition of hot acetic acid, and about 10 per cent. of oxide of zinc is dissolved by caustic potash. It is, therefore, concluded that the sulphide present is sulphide of zinc. The source of the zinc is, doubtless, the ironstone, as small pieces of zinc (blende) are occasionally found in the mines, and I have detected its presence in minute quantity diffused throughout the mass of ironstone. Thallium was detected by means of the spectroscope. A portion of the deposit held on a platina wire in the flame of a Bunsen burner gave faint but unmistakeable indications of the presence of this metal. He was inclined to think that the thallium is not derived from the ironstone, but had some other source, and that its presence in this sample is accidental, as he had examined various other samples of the deposit, both from furnaces smelting Upleathan and Rosedale ironstone, as well as from furnaces using stone from Cleveland mines, for the purpose of detecting the presence of the substance, but without success.

Aluminium and its Application.—Mr. Bell, Mayor of Newcastle, and one of the firm of Bell Brothers, with whose name, in connection with aluminium and its alloys, our readers are already familiar, read an interesting paper upon aluminium, in which he stated that upon the introduction of its manufacture, about four years since, the source of the alumina was the ordinary ammonia alum of commerce, a nearly pure sulphate of alumina and ammonia. Exposure to heat drove off the water, sulphuric acid, and ammonia, leaving the alumina. This was converted into the double chloride of aluminium and sodium, by the process described by the French chemist, and practised in France, and the double chloride subsequently decomposed by fusion with sodium. Faint, however, as the traces might be of impurity in the alum itself, they, to a great extent, if not entirely, being of a fixed character when exposed to heat, were to be found in the aluminia, from which, by the action of the chlorine on the heated mass, a large proportion, if not all, found their way into the sublimed double chloride, and once there it is unnecessary to say that under the influence of the sodium any silica, iron, or phosphorus found their way into the aluminium sought to be obtained. Now, it happens that the presence of these impurities, in a degree so small as almost to be infinitesimal, interferes so largely with the colour as well as with the malleability of the aluminium that the use of any substance containing them is of a fatal character. Nor is this all, for the nature of that compound which hitherto has constituted the most important application to this metal—he meant aluminium bronze—is so completely changed by using aluminium containing the impurities referred to, that it ceases to possess any of those properties which render it valuable. As an example of the amount of interference exercised by very minute quantities of foreign matters, he said that very few varieties of copper have been found susceptible of being employed for the manufacture of aluminium bronze; and hitherto we have not at Washington, nor have they in France, been able to establish in what the difference consists between copper fit for the production of aluminium bronze, and that which is utterly unsuitable for the purpose. These considerations have led us, both here and in France, to adopt the use of another raw material for the production of aluminium, which either does not contain the impurities referred to as so prejudicial, or contains them in such a form as to admit of their easy separation. This material is bauxite, so called from the name of the locality where it is found in France. It contains silica 2·8; titanium, 3·1; sesquioxide of iron, 25·3; alumina, 57·4; carbonate of lime, 0·4; water, 10·8: total, 100. The bauxite is ground and mixed with the ordinary alkali of commerce, heated in a furnace. The metal is so extensively used in the arts as to keep the only work in England—that at Washington, pretty actively employed. As a substance for works of art, when whitened by means of hydrofluorine and phosphoric acid, it appears well adapted, as it runs into the most complicated patterns, and has the advantage of preserving its colour, from the absence of all tendency to unite with sulphur, or become affected by sulphuretted hydrogen. A large amount of the increased activity in the manufacture referred to is due to the exceeding beauty of its compound with copper, which is so like gold as scarcely to be distinguishable from that metal, with the additional valuable property of being nearly as hard as iron.

Manufacture of Steel.—Mr. Spence read an interesting paper "On the Various Processes Employed in the Manufacture of Steel." The new method seemed to aim, for the most part, at making steel by a direct process, without depriving the pig-iron of the whole of its carbon, and without reducing it into a malleable condition. This was effected by extracting a large portion of carbon, but taking care to leave in a sufficient quantity to make steel, the object being to save the great waste of metal attending the puddling of iron, as well as the actual cost of that process. So far as could be ascertained, it would appear that the number of persons employed in this trade in 1838 would be from 70 to 80, and the weight of steel produced annually at that time would be about one-ninth the quantity now produced. The price of steel ranged from about 18*l.* to 112*l.* per ton, according to the description of the quality and the size. This district was highly favourable for the development of the manufacture of steel, owing to the facility and cheapness with which a supply of iron could be obtained from Sweden, freights being frequently as low as 3*s.* 6*d.* per ton. The estimated annual value af the steel manufacture of the district was about 100,000*l.*, giving employment at the present time to about 300 persons, and consuming annually about 15,000 tons of coals. There are in the district 9 converting-furnaces and 52 cast-steel smelting-furnaces.

Occurrence of Titanium in Iron.—Dr. Reilly's paper on titanium in iron stated that the presence of small cubical crystals have been long observed in furnaces, the crystals being always more abundant when the furnaces were used for making the best grey iron. In the examination of the furnaces, titanium was observed in all of them. These red crystals were supposed by Wollaston to be metallic titanium, but they had since been shown to contain the cyanide and nitrate of that metal. Until recently, the source of these red crystals had not been clearly accounted for. Titanic acid had hitherto been considered an oxide, present only in minute quantity, and in minerals not widely distributed. He had found it, however, very widely distributed. In some analyses of Norwegian ore, which he had made, he had found about 30 to 40 per cent. of titanic acid, and about 46 per cent. of oxide of iron. Titanium ought no longer, therefore, to be considered a rarer element, as it occurs very generally, and as a universal constituent to all clays. The Stourbridge brick contained 1·057 per cent. This, he thought, was too low, as it was difficult to determine. The probability is that there is from 1 to 2 per cent., and clearly enough that Stourbridge clays seemed to stand highest, the Newcastle next, and the others following. Dr. Reilly then described the method in which he had determined the amount of titanium, and the experiments he had made to ascertain in what state the titanium existed in pig-iron, whether it was alloyed or not. The conclusion at which he had arrived was that titanium was a constituent part of pig-iron, and that it appeared to have some beneficial effect in the manufacture of iron and steel, somewhat such as manganese had.

Zinc, Nickel, and Cobalt in Cleveland Ironstone.—A short but interesting paper on this subject was read by Mr. John Pattinson. The deposition of considerable quantities of oxide of zinc in the tubes conveying the waste gases from the blast-furnaces in which the ironstone was smelted had long indicated that it contained zinc, although none of the published analyses of that stone mentioned the presence of that metal. The experiments were conducted with a view to ascertain whether the zinc was distributed uniformly throughout the mass of the deposit, or if it only occurred occasionally, filling up small crevices. From 4 ozs. of the stone he had obtained a quantity of zinc equal to ·32 of a grain per lb. of ironstone, or about 10 grs. to the ton. At the same time, indications were obtained of the presence of nickel and cobalt, and a subsequent quantitative analysis showed that the ironstone contained ·72 of a grain of nickel and ·12 of a grain of cobalt per lb. He had further estimated the amount of these two metals in pig-iron, malleable iron, and puddling-furnace cinder, all of which were produced from Cleveland ironstone, without any admixture of the ores. They all contained quantities of nickel and cobalt, varying in the case of the former metal from ·0045 to ·027 per cent., and in the case of the latter from ·0009 to ·003 per cent. An admixture of nickel with iron was said to improve the quality of the latter, but it was scarcely probably that either nickel or cobalt in the preceding proportion would affect the quality of the iron appreciably.

The Chemical Nature of Alloys.—This subject was very ably treated by Dr. Matthiessen, who remarked that our knowledge of the subject was at present very limited, and so far as they could ascertain a liquid alloy of two metals might be either (1) a solution of one metal in another, or (2) a chemical combination, or (3) a mechanical mixture, or (4) a solution or mixture of two or all of the above. On the contrary, an alloy in the solid state might be either (1) a solidified solution of the one metal or the other, or (2) a chemical combination, or (3) a mechanical mixture, or (4) a homogeneous diffusion or mechanical mixture of two or all of the above. But how were they to find out what an alloy was?—chemistry could only afford them the means. By analysis, it was not enough to determine the chemical nature of alloys; the study of their physical properties offered additional means by which the nature of an alloy might be ascertained, and these physical properties might be divided into two classes:—1. Those which do not indicate the chemical nature of the alloy; and 2, those which do indicate the chemical nature of the alloy. The number of alloys experimented with was upwards of 250, and they were all made of purified metals, and the conducting power determined with a modification of Wheatstone's balance, arranged by Kirchoff, under whose directions the first results were obtained. The conclusion drawn from the research on the electric conducting power of alloys was that they might be divided into two classes:—1. Those metals (lead, tin, zinc, and cadmium) which, when alloyed with each other, conducted electricity in the ratio of their relative volumes.—2. Those metals (bismuth, antimony, platinum, palladium, iron, aluminium, gold, copper, silver, and probably most of the other metals) which when alloyed with one another, or with one of those belonging to the first class, did not conduct electricity in the ratio of their relative volumes, but always in a lower degree than that calculated from the mean of their volumes. He had found that the first group of alloys were solidified solutions, and neither mechanical mixtures (with the exception of lead-zinc alloys) nor chemical combinations.

Manufacture of Thallium.—In his paper on the extraction of thallium on the large scale from the flue-dust of pyrites burners, Mr. Crookes mentions the manufacturing firms to whom he was indebted for large quantities of thalliferous dust from their pyrites burners. He had especially to thank Messrs. Allhusen and Sons, and the Walker Alkali Company, of Newcastle; Mr. Spence and Messrs. Roberts, Dale, and Co., of Manchester; Messrs. Chance Brothers and Co., of Birmingham; Messrs. Wilson and Sons, of Glasgow; and the Metropolitan Alum Company. To Mr. I. L. Bell, Mayor of Newcastle, his thanks were especially due for the munificent present of half a pound of metallic thallium, given to him at a time when his researches were in danger of being suspended for want of metal. In the process of extraction 5 tons of the material had to be boiled in water, and then filtered. As a matter of course, the filtrate was extremely acid, and, notwithstanding the most careful watching, the filters would occasionally break, causing a considerable loss of material. Then, again, when left to deposit, so that the solution might be decanted, the residue sets into a hard compact mass, which expands in cooling, and splits the vessel in which it is placed. In this way he had the misfortune to lose many pounds of thallium before experience pointed out better methods. The process he now adopted was this:—The thalliferous dust is first treated in wooden tubs, with an equal weight of boiling water, and well stirred; during this operation a considerable quantity of nitrous acid is evolved; after which the mixture is allowed to rest for twenty-four hours, for the undissolved residue to deposit. The liquid is then syphoned off, the residue is washed, and afterwards heated with a fresh quantity of boiling water. By a further process which he described, he obtained from 3 tons of flue dust 68 lbs. of rough chloride. The next step in the process was to treat the crude chloride with an equal weight of strong sulphuric acid. The sulphate of thallium is dissolved in about twenty times its weight of water, and the solution filtered. On the addition of hydrochloric acid to this solution, nearly pure chloride of thallium is thrown down. After two precipitations, 36 lbs. of nearly pure chloride of thallium was obtained. The object of the process, so far, was to obtain a tolerably pure chloride; but as thallium is most easily reduced to the metallic state from the sulphate, it is now necessary again to convert the chloride into sulphate. For this purpose he added the dry chloride gradually to hot sulphuric acid, using four parts by weight of strong acid to six parts of the chloride. The mixture so obtained is heated strongly until all the hydrochloric acid is expelled, and the residue assumes the form of a dense liquid. This being set aside, gradually solidifies to a white crystalline mass. When this is dissolved in water an immense amount of heat is evolved, and great care must be taken to avoid breakage of the vessels. The best way of dissolving it is to add it slowly to ten times its weight of hot water. A solution is thus obtained which must be filtered, and on being concentrated and set aside to cool, crystals of sulphate of thallium will be obtained, which may be rendered quite pure by re-crystallisation. The final step in the process is the reduction of the metal from the sulphate. After many experiments, he had come to the conclusion that the best plan is to reduce the sulphate by means of zinc. A capacious porcelain basin is arranged over a water-bath. Several pounds of the dry crystallised sulphate are then placed in the dish till the bottom is covered to the depth of an inch or more. Plates of pure zinc are then arranged along the sides of the dish, the lower portions being buried in the crystals. Water is then added till the basin is nearly full, and heat is applied to keep the temperature near the boiling point. In a few hours the whole of the crystals of sulphate of thallium will have disappeared, and their place will be occupied by a dense spongy mass of metallic thallium, and the solution, in supplying the proper tests, will be found to contain none of this metal. The sponge is now to be removed without compression, and well washed in hot diluted hydrochloric acid, and again in water; afterwards it is to be squeezed into a coherent mass by means of a vice. After describing the method of fusing thallium, Mr. Crookes treats of its properties. It is not absolutely identical in colour with any other metal, but approaches nearest to cadmium and tin. Its specific gravity is 11·9. It is very malleable, but not very ductile. It can only be drawn into wire with great difficulty, but by the operation technically known as squirting, thallium wire may be formed most readily. Thallium is very soft, being only exceeded in this property by the alkali metals. A point of lead will scratch thallium with the greatest readiness. Thallium possesses the property, in common with most soft metals, of welding by pressure in the cold. Rubbed on paper, it gives a dark streak, having a yellow reflection, which in a short time nearly fades out, but may be restored with an alkaline sulphide. Thallium is strongly diamagnetic, being in this respect nearly, if not quite, equal to bismuth. It melts at 550° Fah., and distils at a red heat, evolving brown vapours into the air. When a minute fragment of thallium, or any of its salts, is introduced into the flame of a spirit lamp, it colours it of a most intense green. From this property of the metal, it derives its name from a Greek word, signifying a green bud. At the present price of thallium, the employment for pyrotechnic purposes would be out of the question, but a very little reduction in price would enable its magnificent green flame to be employed for ship signals, for which purpose the extraordinary intensity and monochromatic character of the light would enable it to penetrate a hazy atmosphere without the change of colour suffered by ordinary green lights in which baryta is used. The tarnish which forms on the surface of the metal is the protoxide, a powerful base, freely soluble in water, and forming a highly alkaline solution, reacting chemically in many respects similar to solutions of potash and soda. Several thallium salts are sensitive to light.—Prof. Williamson said that there was a very interesting question to consider regarding the place which thallium holds among other metals. Two views had been brought forward on the subject—two chemists of great authority were inclined to place it side by side with silver and lead. If anyone saw a bar of thallium and a bar of lead, he would scarcely know the difference, unless he tasted the thallium, the taste being very perceptible on account of the solubility of

the acid. On the other hand, it had been discovered that the atomic heat of thallium was too great to justify its being classed with lead. Its great amount of specific heat was an argument for placing thallium amongst the alkaline metals, and it would be the last known form of that remarkable class of metals. The greatest objection to this classification was the inertness of thallium—the weakness with which it combines with acids. But they must remember that metals of another class presented the same objection. For example, iodine was sluggishness itself as compared with chlorine.

THE COAL FIELDS OF THE NEWCASTLE DISTRICT.—The inaugural address of Prof. WARINGTON SMYTH, the President of the geological section, was, as might have been expected, particularly interesting, a complete survey of the coal fields of the Newcastle district being embodied in it. He observed that the great carboniferous formation was commonly divided, for convenience, into three principal divisions—the carboniferous limestone, the millstone grit, and the coal measure. The carboniferous or mountain limestone, the oldest group of strata for consideration, might be hastily passed over, but for its presenting in this northern district a transitional type between Scotland and the South of England, no less important in its commercial aspect than interesting to the geologist, in the various enquiries which it suggests. Turn to the Mendips, to Wales, or to Derbyshire, and we find the carboniferous limestone constituted almost exclusively of actual limestone strata, amounting to from 300 or 400 to above 1500 feet in vertical thickness, and never exhibiting other than the smallest traces of beds of coal. But in Yorkshire a change sets in, the carboniferous action, if I may so term it, applies the thin end of the wedge, and small seams of coal of but little value are intercalated among the beds of limestone, and associated with a large proportion of shale and sandstone, stratified with a remarkable regularity. Advancing northwards these seams increase in number and importance through the great Moreland region, which culminates in Cross Fell, the same strata rising from far beneath our feet as we stand here on the Lower Tyne, emerge to the daylight and compose the substances of the penine chain, which, with its lofty and heather-purpled undulations, form the broad dividing ridge of Northern England. The millstone grit, or farewell rock, as it is sometimes called by colliers, embraces a series of strata unproductive in coal, and in which conglomerates and coarse and silicious grits often preponderate. With this rugged crown many of the fell tops are capped; but before it bends downwards to pass under the first strata of the coal measures, we may frequently find with it strata of shale and sandstone and fire-clay, roughly similar to those of the true measures, but presenting to a practised eye peculiarities of structure and colour. As we descend eastward from the higher ground of the moorlands, on the edge of which the first Brockwell seam of coal is traced, and as we find new and higher seams constantly succeeding, and the strata inclined regularly towards the sea, we pass into the midst of that tract which, extending from the River Coquet on the north to near the Tees on the south, for 50 miles in length, forms the great northern coal field. The greatest thickness attained by this formation is, probably, not more than 2000 feet; but it would be vain for me, within a limited time, to offer you details of the strata. Let it suffice to say that, in this thickness, there exist, associated with shales of many varieties, and with fine-grained sandstones, some 37 beds of coal, from 1 inch thick upwards, comprising in all 75 feet of coal; but that what are considered the workable seams are 12 in number, giving an aggregate of about 50 feet of coal. The most famous of these seams, from above downwards, are the High Main, the Yard Coal, the Bensham, Five-quarter, Low Main, Lower Five-quarter, Ruler or Hutton Seam, the Towneley or Beaumont, the Bustey Bank Three-quarters, and the Brockwell. On the east the coal measures are overlaid, in a line running from South Shields, past Houghton-le-Spring, to near Bishop Auckland, by the Permian series, represented by the magnesian limestone and the Lower Red Sand, that unequal and water-bearing bed which forms the great obstacle to the sinking of shafts to the underlying coals. Prejudice, it is well known, even after the difference of these strata from the mountain limestone was proved, long contended that the coal would not be found continuous beneath the magnesian limestone; and it is still asserted that the seams have proved inferior when they pass beneath it, as shown especially by the failure in certain tracts of the Five Quarter and Hutton seams. But no sufficient reason is apparent why such deterioration is not rather to be ascribed to that variation in quality which all seams are found to undergo when followed over a large area, than to the sole influence of an unconformable upper formation. The variation here alluded to exercises an important bearing on the commercial relations of different parts of the field, and whilst the best "household coal," bright, giving a black cinder, and free from ash, extends from the Tyne to the Wear, and from the latter river to Castle Eden, and occupies another area about Bishop Auckland; the steam coal, more dense, and yielding a white ash, characterises the district beginning some five miles north of the Tyne; and the tender coal, best suited for coking, is largely worked all along the line of the western outcrops, from Ryton down to the outskirts of Raby Park. As regards the physical agencies which have impressed its present form on this great coal field, I would remark that they appear to have acted with upheaval in a north and south direction, as evinced by the regular strike over a great length of country. This was accompanied or followed by transverse fractures, resulting in several very pronounced lines of fault. Two of these, running respectively east north-east and east south-east, are the whin or basaltic dykes, named the Hett and the Cockfield dykes. Of the others, the most noticeable is the great fault called the 90 Fathom dyke, which starting from the coast near Cullercoats, where it displaces the strata to that extent, ranges past Gosforth to Blaydon, and then enters on the more hilly ground, may be traced westward to the New Red Sandstone of the neighbourhood of Carlisle. Along this western part of its course its throw is so great as to inlay, as it were, on its north side, in the midst of the limestone district, a long strip of the coal measures of the Newcastle field, and thus to give rise to the collieries of Stublick, Midgeholme, Tindal Fell, &c. The coals and other strata of this field have sometimes been compared with those of Belgium; but when we regard the decided east and west throughing and folding, and the vast number of their seams, which are so noticeable in the latter, we may conclude more properly that it is in the peculiar and often similarly circumstanced coal field of Somersetshire that we have to seek for the direct continuation of the field of the low countries. Upon the mode of origination of the limestone, the shale, and the grit, or post, little difference of opinion is now entertained. That the coal itself has been formed purely from vegetable matter can no longer be questioned. That this dense mass of vegetation swelled over an area frequently subjected to depression beneath the neighbouring waters admit of but little doubt. Such an hypothesis serves to explain not only the equable covering of the coals with their roofs of muddy or sandy matter, afterwards consolidated into shale and grit, and exhibiting to our gaze the remains of molluscs and fishes which tenanted the waters of those depressions, but indicates also the mode in which certain seams have been divided by a parting almost imperceptible in one place, but amounting to many feet in another. The well-known Bustey Bank seam of the western district, some 5 feet thick, including a clay band of 11 inches, is thus divided in a distance of two or three miles, by the increase of the parting to 18 feet, into the stone coal and the Five Quarter at Garesfield Colliery. A still more remarkable instance is the Tow Law seam at these works, 6 ft. 3 in. thick, which, by the increase of a parting as it goes eastward, exhibits at Bowden Close Colliery, only three miles away, two seams divided by no less than 16 fathoms of ground, in which beds of sandstone or chert, and their seams of coal, have been intercalated. Such partings, when composed of shale, are often one mass of stigmaria impressions, and thus form no exception to the generally important part which that fossil plays as the root of the chief plant of the coal; but when the partings consist of fine-grained clean sandstone, showing no trace of rootlets, I confess that the appearance of bright solid coal resting upon them seems to me to demand some other explanation. Instances of this kind, observed in South Staffordshire and in the Whitehaven collieries, induce me to think that the material must in some cases have been introduced between the laminæ, and sometimes even diagonally athwart them, subsequently to the solidification of the coaly matter. But there are several curious phenomena, as to which a doubt frequently arises, whether they are due to action during or after the formation of the coal, and deductions of no small practical importance sometimes depend on the question. Thus, Mr. Hurst has given to the Institute a very exact account of irregularities, especially swellies, or narrow depressions in the low main coal, which appears to have been formed prior to the deposition of the upper seams. On the other hand, Mr. Marcus Scott has excellently described a broad valley of denudation, which was eroded in the coals of the Shropshire field, and filled in with higher unproductive measures. Again, with some of the slips and faults or troubles, we may sometimes observe both coal and ironstone beds so to change in approaching them, or to vary so much on opposite sides of them, that, while in some few cases we may be led to suspect their contemporanity with the beds themselves, there are many more which we cannot explain without supposing that the coal must, at the time of the disruption, have been moulded and squeezed in an almost plastic condition. In the determination of the plants of coal much has been done; but much remains to be done by microscopic enquiry, and by the observation in the pits, of the plants which accompany particular seams. Goppert tells us of certain coals of Rhenish Prussia and Silesia that different seams are distinctly formed of different plants, sometimes sigillaria and lepidodendron, at others coniferæ, and in many stigmaria being chiefly prominent. May we not by degrees connect the peculiar and perhaps varying character of seams with the plants of which they are formed, and may we not advance to a much nearer perception of the true character of those wondrous primeval forests? And here I would remind you that while some of our guides in coal geology incline to the opinion of a marine origin for their plants, thus bringing them into natural contact with the fishes and the probably marine shells often found in the shales, others insist on a terrestrial vegetation, and a third on that of lagoons, or sea-swamps and bogs. The last few years have given more heavy arguments to those who insist on a lurid forest, however near to the water's level it may have been. We but recently knew that among these giant stems of sigillaria the busy hum of flying insects and the merry chirp of the cricket were heard, that scorpions curled their ominous tails, that land shells crept slimily along, and that several genera and many species of reptiles either pursued their prey along the ground or climbed the trees, where hollow trunks have formed the casket to contain their remains. Here, then, is a goodly population to vivify the scene which only a few years ago was held to be almost wanting in all but vegetable life; and when we consider the accidents which have, amid the great decomposition of organic matter, preserved to us these remains, generally enclosed in ironstone nodules, we must feel confident that coming years will have many an additional fact to disclose. Of the whole range of the carboniferous formation, perhaps the most interesting in several respects is the lower division. Many years ago Prof. Phillips described the peculiar group of unquestionably marine shells occurring in the roof of the Halifax coals; and my friend Mr. Binney has traced throughout the length of Lancashire several seams which are thus characterised, and which are invariably below the thick seams of the main coal field. Again, they occur very similarly in South Wales, at Merthyr and Nant-y-glo, and further west in the Kilkenny coal field. I have devoted at intervals several days to the search for them in this coal field, but hitherto unsuccessfully; and while their occurrence lends great force to the probability of the original unity and the subterranean connection of most of our coal fields, their apparent absence in the Durham and Cumberland lower coals appears to indicate a peculiar difference in the conditions of deposition. The identification of distant seams, and of low as compared with high measures, appeared on this evidence very feasible, but Mr. Hull has not long since shown that caution is still needed, by announcing the occurrence of the same group in a higher seam in Lancashire. It is well known that the ironstone bands are among the most prolific sources of the objects of these studies, and he must, in conclusion, refer to the very interesting lists and parallels of fossils prepared by Mr. Salter for the two last numbers of the "Iron Ores of Great Britain," in the Memoirs of the "Geological Survey." The rich stores obtained by zealous collectors in South Wales, and yielded by the productive strata of the Potteries' coal fields have been formed under his careful hands into a very valuable foundation, upon which he hoped they might soon see in course of erection a systematic and comparative natural history of the British coal fields.

THE COAL AND COAL TRADE OF THE NORTH OF ENGLAND.—In an elaborate paper on this subject, Mr. N. WOOD gave a description of the northern coal field, including the dykes intersecting it, and other prominent features, in describing which he exhibited a Coal Trade map. The coal field reposes upon, and is conformable to, the millstone grit series of rocks, and it is covered, on the south-eastern side, by the low new red sandstone and magnesian limestone, commencing at the northern outcrop, near the mouth of the Coquet, and taking a circuit round the edges of the basin, the lowest coal beds crop out to the surface. From this point and all along the western edge of the basin southwards, the coal beds, rising gently from east to west, consecutively crop out to the surface over the lands of Biagdon, Ponteland, the ancient commons of Throckley Fell, Hedley Fell, Lanchester Common, Wolsingham Common, Hamsterley, Evenwood, and Brusselton, crossing the Tyne near Horsley Wood, and the Wear to the west of Witton Castle. The speaker went on to point out some peculiarities incidental to the coal field proper. Two extensive and considerable slip dykes, or faults, cross the entire coal field, from the sea near Cullercoats on the east, to Tynedale Fell on the west. Another dyke is the Butterknowle. There are several basaltic dykes likewise crossing the coal field, and have generally an east and west direction, apparently proceeding out of the great basaltic bed, called the Whin Sill. Some of the peculiarities of those dykes were then adverted to; after which the speaker made some observations on the underlying strata within the counties of Durham and Northumberland. The economic uses of the various beds of coal in the North of England passed under review, the various descriptions being given under the heads of household fire coal, gas coal, manufacturing coal, steam coal, and coking coal, briefly mentioning the localities where each are found, and their relative qualities. In an account of the early history of coal and coke, he gave a *resume* of the early notices which the mineral received by ancient authors, and detailed the early history of many of the local collieries. Cockfield Fell Colliery is recorded as one of the earliest in the county of Durham, and in 1379 the first Government tax was laid on coal. The various imports, and the charges made on them, were also briefly noticed. Coke was used in 1640, and after its introduction the coal counties assumed a far greater importance in connection with iron than the woodland districts had done. Mr. Wood then read a statistical statement of the development of the coke and coal trade up to the present time. In 1860, the total number of collieries were—England, 2074, producing 63,870,123 tons; in Wales, 481, producing 8,561,021 tons; in Scotland, 424, producing 11,081,000 tons; in Ireland, 73, producing 123,070 tons: total number of collieries 3052, producing 83,635,214 tons. And out of the 34,000,000*l.* value exported from Great Britain, coals formed 20,906,803*l.* Other statistics of the yields of coal, coastwise and foreign, from 1791 to 1862, were also read, followed by an account of new discoveries, and their application, connected with the coal and coke trade. Wooden rails were introduced between 1642 and 1649, and were in general use between the years 1670 and 1680. In 1815, malleable iron rails began to be used instead of cast-iron, which had been in use from 1794, being partially used in Walbottle Colliery at that time. After an elaborate chronological notice of the various inventions bearing directly on the coal trade, the sinking of pits and drainage of mines were considered, and the difficulties met with pointed out. They are chiefly—from quicksands immediately below the surface; from quicksands underlying the magnesian limestone; from large feeders met with in sinking through the magnesian limestone, and many of the coal measure sandstones. The drainage of mines, the modes of working, the ventilation and lighting of mines, and the underground conveyance of coal, were reviewed at great length. After the introduction of steam-engines, and when it became necessary to sink deeper for coal, tramways were introduced (in 1777), and superseded the use of sledges in conveying the coal from the workings to the bottom of the shaft. Afterwards edge rails were introduced above ground, and they were likewise adopted underground. When sledges were used, baskets (corves) made of wicker work were placed on them, and so conveyed to the shaft: and even when wheel carriages were first adopted, sledges were still used in the vicinity of the workings, and stations were fixed upon, and small cranes were employed to lift the baskets or corves upon the carriages, and they were so conveyed from the various stations along the main roads to the shaft. After small wheel carriages were introduced, the same arrangements were pursued at the stations, cranes being still used to lift the baskets and place them upon larger carriages, or "rollies." When baskets, or corves, were used, which was the practice for several years, they were drawn up the shaft by steam-engines; but, as they were thus subjected to great wear and tear from the sides of the pit, and were also themselves productive of great injury to the sides of the shaft, various contrivances were adopted to remedy this expense. At last a plan, previously used in the collieries of the midland counties, of placing timber slides in the shafts, and of drawing up and down the shaft a platform, or cage, made to work within such slides, was adopted. Since then tubs, or boxes, of timber or iron have been almost universally used. By this mode the coals are brought out of the working places in single tubs, and are drawn by ponies to the stations, from whence they are taken by fixed steam-engines, self-acting incline planes, or horses, from the stations to the shaft. It is at all times a subject of vital importance to the trade to economise, as far as practicable, the conveyance of coals from the workings to the bottom of the shaft, the more so as coal at much greater depths from the surface, and also much greater distances from the shafts, being now worked, and the pits being more expensive to sink, they are, consequently, much further apart. A consideration of the effects of the introduction of railways and locomotives, screw steamers, and inland competition on the commercial character and state of the northern coal trade formed the subject of another division of this able paper; and in concluding his observations on the duration of the coal seams, the speaker said:—It has been intimated that it would be very desirable that some observations should be made on the duration of the northern coal field. No doubt the quantity of coal yet to be worked in that coal field is a subject of national importance; but, from the observations already made, it will have appeared that such a calculation is attended with more than ordinary difficulty. The form of the coal field may be said to be that of an oval basin, elongated north and south. On the western side of the basin the outcrops of the seams are pretty well defined, but more than one-half of the basin appears to be covered by the sea, under which at present it may be said that no explorations have been made. We have stated that the line of the sea coast does not pass over the line of the deepest part of the basin, but that for a very considerable distance the beds of coal dip to the east, or underneath the sea. We do not know how far beyond the sea shore the beds dip underneath the sea, or at what distance beyond the line of the coast the greatest depression of the coal beds will be found. Until further and more extensive explorations determine this, we are completely at fault as to the quantity of coal lying underneath the sea. We see, therefore, the difficulties which we have to encounter in approaching such an enquiry, and we naturally ask ourselves can such an enquiry at the present moment be of the least practical utility? We have not yet reached the threshold of such a conjecture. We have not yet explored one square mile of this vast unknown space, or determined one of the many elements required in such an intricate and uncertain investigation, and we have come to the conclusion that, such an investigation can be of no practical utility, and that the attempt, for a vast period, is at the least premature.—The CHAIRMAN said that it was desirable to obtain a geographical geology—if he might so speak—of this district; and he called upon Mr. Sopwith, who was so well acquainted with the limestone district lying in the rear and to the west of the district described by Mr. Wood. He asked Mr. Sopwith to complete the geological information by a few observations, which would be of service to all those who were, for the first time perhaps, making acquaintance with the general geological features of this district, and more particularly to those who proposed to join in the very interesting excursion to Allenheads, to see the lead mining district.—The CHAIRMAN said that when Mr. Wood touched upon the duration of the coal field—a subject of vital importance ultimately to this district as well as to this country—they could not but feel that although, as he said, it was not yet time to speak with any definitiveness of the quantity of coal still in store for us, it was a subject of the very highest interest; and those of them who were a good deal startled by what Sir Wm. Armstrong said in his address, would be more desirous that an opportunity should be afforded to those who might have something to say upon the subject.—Mr. WOOD said the duration of the coal field was a subject which they were very far from being able to go into with any degree of satisfaction; but looking to the facts he had stated with reference to its extent, and seeing it was more a matter of extent of demand and quantity of coal used than extent of the coal, he might say he questioned the accuracy of Sir Wm. Armstrong's conclusion. He thought Sir William had overlooked the importance of that part of the coal which is under the sea. The other part of the coal field was pretty accurately ascertained; but of the extent under the sea they had no knowledge, and no real facts whatever. They had not really worked an acre of coal under the sea; and, therefore, he thought it at least premature to go fully into the enquiry at present. He might add that whatever feelings he might have for the Americans, he hoped it would be long before they supplanted us in the production of coal. The gentlemen connected with the coal trade were quite ready to go into the duration of the coal field whenever they had laid before them any facts which bore upon the subject; but they had decided at present that it would be inexpedient and illusory to do so.

THE ALLENHEADS LEAD MINING DISTRICTS.—Mr. SOPWITH, in an interesting outline of these districts, observed that the mountain limestone districts extend from 20 to 30 miles further west than the outcrop of the coal measures; and in the whole of that district mountain limestone beds come out from beneath the coal strata, and continue to rise with a very gradual ascent until they reach the mountain of Cross Fell, in Cumberland, an elevation of 2901 ft. above the level of the sea, being the highest elevation that is connected with the carboniferous formation of this district. Having arrived at this distance of from 20 to 30 miles from the boundary of the coal fields, we come to one of those great dislocations which had not yet been alluded to, because it distinctly belongs to the series of mountain limestone beds, and is not at all associated with the district which his friend, Mr. Wood, had so ably brought under their notice. It was one of the greatest we have in the North of England, amounting to between 4000 and 5000 ft. As regards the mountain limestone in England generally, their President had, in his address, given them a general view of the manner in which this formation is found in different parts of England. But as they were now more immediately concerned with this northern portion of it, he would mention that no sooner had the beds of coal of the Newcastle coal fields cropped out than there occurred a few thin beds of shale and sandstone; and we then come to a bed of limestone, called the Fell Top limestone, only about 2 or 3 ft. in thickness. This limestone is found occupying the hills which intervene between the boundary of the coal field and Cross Fell. Near Allenheads and the Fell Top limestone is found at the summit of the hill. Again, on the mountain which separates the rivers Tyne and Nent, it is found at the top of that hill, for a very short distance; it is then entirely denuded, or carried away in the valley of the South Tyne, and again found on the east, and afterwards on the west, side of Cross Fell mountain,—not far beneath the summit. Beneath this Fell Top limestone no other bed of limestone is found for a considerable distance—a distance of some hundred fathoms; we then come to another limestone, not much more important. A short distance below it is a bed of limestone, 60 ft. in thickness; this is the thickest and most important bed of limestone in this district. It is called, therefore, *par excellence*, the great limestone; and its importance, in an economical point of view, will be obvious when he mentioned that of all the lead obtained through the various mining districts of Alston Moor, Weardale, and Teesdale, fully three-fourths is obtained from the great limestone. The way in which lead is found in the great limestone, and other strata beneath it, is by mining in those veins, fissures, and faults which annoy and disturb the work of coal mines, but which were the special object of the lead miners' search. He might mention that at the last meeting of the British Association he had the honour to bring before that body a detailed section, 30 feet in length, showing minutely every bed from the top of Cross Fell down to the very lowest measures in which the mines were worked. He had not, therefore, thought of repeating any detailed description of this subject, especially as an excursion had been planned to Allenheads; but if any gentlemen were particularly interested in such details, or if it were thought by the President that its exhibition would be interesting, he was quite sure Mr. Beaumont, the owner of the mines which were placed under his (Mr. S.'s) direction, would have great pleasure in affording opportunities for inspecting it. Mr. Wood had referred to the distance to which coal was carried underground; and he (Mr. S.) might observe that several operations of lead mines are also measured by miles now, whereas formerly they were only measured by fathoms. In 1775, Mr. Smeaton, the well-known engineer of the Eddystone Lighthouse, planned a level or underground gallery for exploring mines, which was driven three miles in length upon one water level, and other two miles in length in higher strata. Mr. Beaumont was at the present time engaged in forming a level which would be nearly seven miles in length, and would have the effect of opening out the lead measures of the district of East Allendale, which were to be visited by the excursionists.

ORGANIC CONTENTS OF LEAD VEINS.—In a paper on this subject, Mr. CHARLES MOORE remarked that at the last meeting of the Association he made some observations on the presence of organic remains in mineral veins; and seeing that one of the excursions is to be made to the Allenhead Mines, he thought it might not be inappropriate if he again reverted to the subject, and made a more special examination of the vein stuff from these mines. He placed himself in communication with Mr. Sopwith, who, through Mr. Bewick, of Allenheads, had kindly furnished him with several lots of samples. He had also to acknowledge his obligations to the proprietors of the Grassington Mines, near Skipton, and also from the Alston Moor and White Mines of Cumberland. He need scarcely remark to those acquainted with mining operations that the contents of mineral veins are often as varied in their character as they can well be; being in general highly mineralised and, dense, at other times varying from a conglomeratic infilling to materials more nearly approaching the marls and clays of stratified deposits. A close examination of the latter, at whatever depth they may be found, gives evidences of having been derived, some probably from the denudation of older rocks, which have been re-deposited with their organic contents in the then open fissures of the veins; others from younger deposits, showing that the rocks in which the veins are found were then either at the bottom of the ocean or within its influence. That the deposit in the veins was at times very slow, is shown by some of the clays being composed of as thin laminæ as if deposited in horizontal beds. On having the specimens of the material before them, nothing could look more unpromising to the eye of a palæontologist. The most sanguine would scarcely expect that anything like an extensive fauna could be derived from it; and yet he had before him, probably, from 160 to 170 species derived from carboniferous limestone veins alone. The first step in their discovery is to wash the vein stuff, floating away as much as possible of the finer material, in doing which, from some of the mines, you cannot but be struck with the great beauty and variety of the tints produced, the water being coloured, by the different specimens, from the most delicate French white to the densest black. In the sediment remaining after the washing the organic remains are to be sought for. So abundant are they, in some instances, that ¼ oz. in weight has yielded as many as 156 specimens; whilst others still remain in the deposit. Numerous though the organic contents may be, it is not to be expected that they are to be found in every sample selected somewhat promiscuously from a mine. Those that are very mineralised or crystallised may be at once set aside as barren. Recently, through Mr. Bewick, he received eight samples from Allenheads; these being much mineralised, organic remains were found in three samples only; but, in six others more recently sent, and more carefully selected, he had found remains in every instance. The samples referred to above weighed from about a pound to about an ounce; and, although in general selected by accident from the mines, and without his object being known, about one-half of them had been found to be fossiliferous. The lowest depth at the Allenheads Mines in which he had yet traced organisms was 678 ft., but there appeared no reason for supposing that they might not be obtained from the lowest workings. In a former set of samples, sent to him from Weardale by Mr. Cain, 13 out of 29 were fossiliferous. At Alston Moor Mines, in Cumberland, they had a deposit of the same mineralogical character, and containing precisely the same genera and species. After referring to other mines, he continued that he had stated that identical organisms occurred at certain depths at Alston Moor and Weardale, placing them, probably, on the same horizon. It might be a very difficult matter for investigation, but he believed it possible, by a consideration of this question, that certain horizons in mines might be established, not so clearly, of course, as in stratified deposits, but such as might enable a mine manager to know his position relatively with mines in other neighbouring districts, and thus know whether he might, and at what distances, be passing into barren or paying ground. Further, he believed those investigations would assist to establish the fact that minerals are due, not to plutonic, but to a very opposite agency.

GOLD IN WALES.—In an interesting paper on the recent discovery of gold near Bala Lake, Merionethshire, by Mr. T. A. READWIN, he remarked that the discoveries of gold in Merionethshire have, of late, been rather frequent. In some instances the appearances had been of such a character as to justify expectations of profitable results. Last year, at Cambridge, he enumerated the gold localities in the neighbourhood of Dolgelly, and now proposed briefly to notice a recent discovery of gold near the beautiful lake of Bala (Llyn Tegid). About five miles from Bala, on the north-west side of the turnpike road leading to Dolgelly, and about two miles from the village of Llanerchllyn, nearly opposite the western end of the lake, is a prominent hill, known as Castell Carn Dochan. At the top of this hill are the ruins of a castle of the olden time, and at the foot of the hill runs the swift little river Lew (Avon Lew) on its course to the lake. Geologically, the district is similar to that now popularly known as the "Dolgelly Gold District"—the Lower Silurian rocks, penetrated by large bands and bosses of porphyritic greenstone. At the Castell Carn Dochan Mine there is one auriferous quartzose lode very remarkable. It runs nearly N.E. and S.W., and has a dip to the south. This lode is exposed to view for about 12 fms., showing gold in specks nearly the whole distance. The lode stuff is for the most part free from sulphides of lead, zinc, and copper. Occasionally metallic gold is found richer than the large specimen now before him. The quartz has a different appearance to that at Clogau and Dolfrwynog, and resembles more closely that at Clunes, in Australia. Some boulders of quartz weighing from 2 to 4 cwts. have been broken up, and found to contain visible gold throughout. The largest boulder had been built into a wall, near the spot where it had fallen. The upper portion of the lode appears to have slipped over the lower, and down the face of the hill, leaving behind it a record of where it had been, in characters of gold. Several tons weight of this lode stuff had been collected, some of which has yielded gold at the rate of 18 ozs. to the ton. It is interesting to notice large loose masses of greenstone lying about, having upon them an incrustation of quartz, spangled with small particles of gold. The debris, of which there is a considerable quantity, yields gold of equal value with the lode stuff. Specimens of quartz have been found, showing gold as rich as any that has been found at Clogau, where 32,000*l.* has been realised from the gold produce of less than 1300 tons, averaging about 6¼ ozs. to the ton; a result, he believed, unparelleled in the world's history of gold quartz mining. Operations have been commenced at the mine by driving an adit into the face of the hill to cut the lode at the depth of about 20 fms. This level has been driven to within 6 ft. of the lode, which, if found as rich at that depth as the sample on the table, it very probably may yield as profitable results as the St. David's gold lode, at Clogau. The gold is not associated with sulphides in excess, so that its extraction is exempted from the difficulties generally attending the various processes of amalgamation. This is an important fact, and one which greatly enhances the commercial value of the discovery.

THE CUMBERLAND COAL FIELDS AND NEW RED SANDSTONE.—Mr. MATTHIAS DUNN, the Government Inspector of Mines for the Northern District, submitted a few remarks, especially referring to some important facts which had recently been exhibited at the collieries of Ellenborough, Aspatria, and Crossby. The bearing of the former paper was to show that the New Red Sandstone was traceable from St. Bees through the collieries of the whole line of coast, and up to the vicinity of the village of Aspatria, where some new sinkings had recently been made by the representatives of the late Capt. Harris in the New Red Sandstone, and short driftings had led directly into the main coal field towards Bolton and the neighbouring mountain limestone. At the Ellenborough Colliery the explorations had reached to the town of Maryport in the Ten Quarter seam, at the depth of 100 fathoms, and had there been suspended at troubled coal, attended with very great thickening of the band with downcast troubles. Very much the same circumstances have attended the working of the Crossby Colliery at the depth of 70 fathoms—a set of dykes and bad coal, about the same course as the margin of the Red Sandstone, terminating the profitable working of the Ten Quarter seam. To the northward of the above line of explorations, and down to the Solway, no operations in search of coal had been carried on, but sundry quarries have been worked, showing the Red Sandstone to be lying in regular strata, with a westerly dip similar to the coal measures. From the above facts he had been led to form the idea that the Red Sandstone is but the superior strata of the coal field, and that the neighbouring coal seams will be found underneath; and judging from the flatness of the country around Silloth Harbour, he had assumed that the bottom of the basin will exist in that quarter, for appearances of a coal outcrop exist in the neighbourhood of the Criffle Mountains, in Kirkcudbright. In pursuance of this theory, he assumed that the coal field of Canonbie is similarly circumstanced; for the Red Standstone there crops out contiguous to the pits, and the nature of the various seams of coal simulate closely upon those of Cumberland. Another corresponding fact attends the colliery of Kirkhouse, belonging to the Earl of Carlisle, although a portion of it also contains coals belonging to the limestone formation. He had compared the sandstone in the neighbourhood of Maryport with that upon Sir James Graham's property at Netherby, and that they were found identical—that is, the upper portion—the lower portion of the beds being of a much paler colour, and approximating towards the specimens of the ordinary coal sandstone. The deepest perforation which has yet been made in the New Red Sandstone was by Mr. Cockburn, paper-maker, near Wetherall, who bored in search of water, but failed in obtaining a supply. In a letter in August, 1862, he said the hole is standing 600 feet from the surface, 50 feet of clay, and 550 of red rock, which experiment shows that the rock is remarkably free from water, and that the sinkings would in all probability be free from those expensive operations incurred elsewhere. But the most convincing argument as to his theory had been furnished by the Aspatria Colliery, belonging to the representatives of the late Capt. Harris, a plan of which, with its connection with the Red Sandstone, and exhibited herewith, showing that sinking took place in the red sandstone, with a drifting into the main coal field, and the belief of the managers that their coal was thrown down and passed underneath the said sandstones; all around the village and down to the Solway exhibiting nothing but red rock. Since he first promulgated these opinions, he had found that many persons in the district had come to the same conclusion, although certain geological objections had been started. However, he had resolved to state the foregoing facts, to be canvassed and determined by an association of gentlemen so well able to dispose of the subject, which is supposed to comprise one of the greatest fields of coal yet untouched, and which in future generations may uphold England's greatness, and which may not have been considered in Sir W. Armstrong's able elucidation as to the duration of our northern coal fields.

THE COAL TRADE OF THE NORTH.—From the paper read by Mr. BELL, the Mayor of Newcastle, it seems that 20,000,000 tons of coal were raised in the North of England in 1862, and that 4,000,000 tons of this coal were transformed into 2,250,000 tons of coke. The annual make of iron in the northern district is from 600,000 to 700,000 tons: 450,000 tons are consumed by the local forges when in full work. The foundries of the Tyne turn out nearly 50,000 tons per annum, and those of the Tees double the quantity: 3000 tons of steel are produced on the Tyne; 5500 to 6000 tons of lead are smelted in Newcastle and the neighbourhood, and upwards of 19,000 tons of manufactured lead are produced. From 4000 to 5000 tons of iron wire and 3000 tons of hemp are spun into rope upon the banks of the Tyne and Wear; and 2500 tons of anchors and 11,000 tons of chain are forged on the Tyne. Nearly one half of the whole raw material used in the manufacture of alkali is worked up in the Tyne; 50,000,000 glass bottles are turned out of the furnaces of the Tyne, the Wear, and the Tees yearly; and five-sixths of the window glass made in the kingdom proceeds from the manufactory of Mr. James Hartley, the mayor of Sunderland.

THE IMPORTANCE OF GEOLOGY.—In his inaugural address to the Zoological and Botanical section, which includes Physiology, Prof. BALFOUR, pointing out the importance of the subjects embraced in the section, remarked that these subjects were biological, having reference to the structure, physiology, and distribution of living beings. Man, animals, and plants were alike included within the scope of these researches. Although this section was separated, for convenience, from that of geology, nevertheless they have important bearings on each other. The study of palæontology cannot be prosecuted without a thorough knowledge of the anatomy, mode of growth, and geographical distribution of the plants and animals of the present epoch. In fact, the study of fossil plants and animals ought to constitute a part of every course of botany and geology. Geology, in place of being reckoned a distinct science, may be considered as the means by which the departments of mineralogy, botany, and zoology are combined in one harmonious system, embracing the natural history of the globe. Rash geological statements and conclusions often arise from imperfect knowledge of the sciences included in this section. Fronds of ferns of differently internal forms have been described as distinct fossil species, or even genera, the geologist not knowing that very different forms of frond are exhibited by the same species of fern in the present day. Again, another error has arisen from the same form of frond being considered as indicating the same species, whereas the same form does occur in different genera in the present flora, and these can only be distinguished by the fructification which in fossil ferns is rarely seen. So also the same forms of shells may belong to different genera, the only delineation being founded on the teeth or some other characteristics of the animal inhabiting the shell, and such characteristics are, of course, totally lost in the fossil. These and numerous instances might be adduced to show the necessity for a perfect acquaintance with the present fauna and flora, in all their details, before the geologist can determine fossils or the character of the climate of palæontological epochs. There is a mutual bearing of all the natural sciences on each other, and the student of nature must take a comprehensive grasp of all. The natural sciences have always ce-

cupied a prominent place in the proceedings of the British Association. The subject is in itself popular, and is interesting to all classes. Much has been done in this section to advance the sciences of zoology and botany, and to stimulate naturalists in their investigations. A feature of the Association which requires special notice is the procuring of reports in different departments of science, and the aiding and encouraging of naturalists in surveying, or researches which require much labour and expense for their prosecution. Many a deserving young naturalist has thus been enabled to advance science, and lay the foundation for future fame and promotion. Another important feature of the Association is the bringing together men of science and promoting free personal intercourse. Perhaps more good had been done by that than the reading of papers. Interchange of thoughts by oral communication, and the opportunity of frankly stating difficulties, and of asking questions, are most valuable to men of science, especially when they are congregated from various parts of the world.—The sub-section, Physiology, was presided over by Prof. ROLLESTON.

SUPPORTING LIFE IN FIRE-DAMP.—An interesting paper, read by Dr. B. W. RICHARDSON, "On a Miners' Safety Mask, for Supporting Life in Fire-damp and other Noxious Vapours," the substance of which was given by Dr. Richardson on Monday, was handed in:—In conducting a series of researches on the narcotism arising from various poisonous vapours, the idea occurred to me that it would be possible to construct a mask which the miner or other workmen could wear while exposed to carbonated hydrogen and other poisonous gases in mines, for the same purposes of protection as the miner uses the safety-lamp. His researches had been carried out in three directions:—1. To construct a mask that shall give oxygen to the workmen in cases of necessity.—2. To construct a mask that shall render the ordinary oxygen more active to meet the effects of the poison.—3. To construct a mask that shall separate the poisonous gas from the air. Regarding the first of these plans, he would say that as yet there is no known substance which will yield sufficient oxygen at the temperature of the breath to enable a mask to be constructed that would be portable and of immediate application. The second method is the one that promises most important results. In this principle a mask is required having a double valve, acting like a Sneid's inhaler for chloroform. The air in this case, as it enters the lungs, is made to pass over bodies which have the effect of ozonizing it, of rendering the oxygen more active, and of decomposing, to a limited extent, the dangerous products. Up to this time he had found iodine most effective as the chemical substance for rendering the air more active. Iodine can be used with the double-valve mask in a most simple manner. By attaching a small box, containing perforated plates, to the inhaler beneath the valve for the entrance of the air, and by placing the iodine on these surfaces, a little chamber is made (which may be opened or closed at pleasure), and through which the air may be drawn. A mask of this nature may be constructed to last for months, or even years. He had inhaled through a mask so constructed, and had performed some experiments, which show that in small animals life can be prolonged for a period of three minutes beyond the time when other animals died in the same gas, but without the interposition of iodine. He did not consider this result sufficiently important to lay much stress upon it, although he conceived that a man's life might be saved by his being shielded from danger even for that brief period; but he wanted to advance farther than this; he wanted to make a mask that should be a protection for half-an-hour or an hour, and that should be put on the face as readily as a dancer puts on his mask at a masked ball—a mask that shall, in a word, act to the lamp of life as effectually as the Davy lamp acts towards the lamp of oil. Of the third method of constructing a mask, through which the air should filter, so as to separate the noxious gases from the oxygenated air, he had not much to say. There is here a wide and great field to be explored. Experiments admit of being extended, for drawing the air through gauzes of different metals, over such bodies as spongey platinum, for instance, and through porous earthy surfaces. If a mask could be made on this system, it would naturally supersede all others, as it would be permanent, and always ready. He thought it possible that the recent labours of Mr. Graham, on the separation of gases, might assist in this direction; but the subject is too new to admit of discussion at the moment. He had felt it important to bring this subject forward for two reasons—first, to record what he had done; and, secondly, to point out lines of work for other labourers. He did not know whether he might be so fortunate as to complete a miners' safety-mask, but he was confident that the invention, once put in hand, before the next meeting at Newcastle, will be an accomplished fact.

THE EFFECTS OF THE RECENT GOLD DISCOVERIES.—An interesting paper, pointing out the evils which would attend a depreciation in the value of gold, was read in the Economic Science and Statistic section, by Mr. H. FAWCETT. He said the public had not yet in the least degree recognised the very important results which would be produced by a depreciation in the value of gold. It was no exaggeration to say that such a depreciation, affecting the value of every fixed money income in the country, would be felt more or less acutely by almost every family. Mr. Fawcett was aware that the subject was surrounded with so many uncertain conditions, that he should carefully avoid indulging in positive predictions; but many reasons could be advanced in favour of the opinion that the value of gold had already become depreciated; and it could undoubtedly be proved that such a depreciation might very possibly occur during the next few years. He believed that there would not be a sudden depreciation in the value of gold—it would take place gradually; it would become depreciated month by month in an almost imperceptible degree, so that it would be difficult to discover it, unless they looked over a very considerable space of time. The idea should not be for a moment encouraged that fundholders, if losers by the decrease in value of gold, had any fair claim for compensation. (Hear, hear.) If all of them who believed the depreciation of gold would take place took warning, they would take remedies to avoid its worst effects on themselves; while if people persisted in disbelieving, they must abide by the consequences. He thought the change from gold to silver payments would not be desirable, because he believed silver was quite as liable as gold to change its value at the present time.—Mr. DOUBLEDAY, of Newcastle, said he was of opinion that gold, as a currency, had not depreciated in this country, nor in any country of Europe; whether it had depreciated as merchandise was a different question, but as a currency he regarded it as impossible that it should depreciate.

ENGINEERING MANUFACTORIES OF THE TYNE AND NEIGHBOURING DISTRICTS.—In the Mechanical Science section, presided over by Prof. WILLIS, of Cambridge, the formal business was followed by a paper on Richards's "Indicator for Steam-Engines, by Mr. C. T. PORTER, after which Mr. P. WESTMACOTT read a long and interesting paper (prepared by himself and Mr. J. F. SPENCER) "On the History and Development of the Engineering Manufactories of the Tyne." In 1747, the Gateshead Ironworks were commenced, and the present proprietors, Messrs. Hawks, Crawshay, and Co., had one of the largest engineering establishments on the Tyne. In 1793, millwright work was undertaken at Chester-le-Street, paper, lead, corn, and other mills being constructed and supplied to all parts of England, Scotland, Ireland, and abroad; in 1826, a large foundry business was added. In 1809, the Walker Ironworks, owned by Messrs. Losh, Wilson, and Bell, were commenced, and, as in the two establisments already mentioned, the variety and extent of engineering work rapidly increased as the demand arose for an improved class of machinery and motive power. In 1784, one of Watt's steam-engines was erected for the owners of Walker Colliery, by Messrs. Boulton and Watt. In 1805, this engine was purchased by Mr. Losh for the Walker Alkali Company, and it might yet be seen working daily at Walker, with its wooden beam and bed-plate, and sun-and-planet crank motion. In 1817, Mr. R. Hawthorn, the present senior partner of Messrs. R. and W. Hawthorn, established the Forth Banks Engine-works—the increase from eight men, in 1817, to nearly 1000 in 1862, indicating very forcibly the progress of this well-known establishment. In 1830, Mr. T. D. Marshall, of South Shields, commenced the building of steam-tugs, and fitting them with machinery; and in 1838 the Hartlepool Ironworks were established by Messrs. T. Richardson and Sons. In 1844 the Tees Engine-works were established; and in 1847 the Elswick Engine-works were commenced with about 200 men, and although then only engaged in the manufacture of hydraulic and general machinery, there had been at a later period, when, with the manufacture of the Armstrong guns (1858), the number of hands employed had amounted to upwards of 4000. As the increasing commercial interests of the country, and the improvements matured in steam-power, gave a fresh impetus to engineering manfactures, the undoubted advantages and facilities of this district were appreciated and availed of by Messrs. Palmer Brothers in 1852, Messrs. Morrison in 1853, Messrs. Thompson in 1856, and Mr. D. Joy, of Middlesborough, in 1862. In referring to the progress and present condition of the engineering manufactures of the Tyne and neighbouring districts, the subject was classified under the following heads:—1. General Machinery and Mill-work.—2. Stationary and Steam Engineering.—3. Locomotives.—4. Marine Engineering.—5. Hydraulic Machinery.—6. Iron Bridges, Viaducts, Lighthouses, &c. Under the first head, reference was made to the magnitude of the work undertaken by some of the firms already mentioned; and single castings had been supplied from 45 tons downwards, and there were capabilities for turning out castings of even 60 tons. Among the engineering specialities of the district must be mentioned many large winding and blowing engines, Messrs. Hawks and Co. having cast and bored cylinders of 108-in. diameter for this class of engine. In the locomotive department, notice was made of the Stephenson "Rocket" of 1829, and the Hawthorn "Comet" of 1835. A table was added, showing that during the last 34 years there have been upwards of 2400 locomotives manufactured by Messrs. Stephenson and Co., R. and W. Hawthorn, Gilkes, Wilson, and Co., and Sir W. G. Armstrong and Co. Reference was also made to the first application of steam-power on the Tyne for towing purposes, which was coeval with Henry Bell's "Comet" in the Clyde in 1812. In 1814, the first steam-tug, the "Perseverance," was fitted and started on the Tyne, there being only 17 steamboats in existence. At the present time there were upwards of 250 of what might be called "native steam-tugs" on the Tyne, besides nearly 100 more in the ports of Sunderland, Stockton, Middlesbro', and Hartlepool, and the engines in all these were almost identical in type with those fitted in 1820. Some interesting particulars were given under the head of hydraulic engineering—first, as to the application of machinery to pumping, either for removing or supplying water; and, secondly, to the application of machinery in using water as a motive power. Nearly 1800 hydraulic cranes, hoists, and other machines of this description had been applied, and 174 steam-engines, having a collective power of more than 5200-horse power, were employed in supplying the pressure required for working them. In addition to these, 177 hydraulic engines of various forms and powers had been produced, and 23 moveable bridges received their motive power from hydraulic machines. The art and manufacture of iron bridge building, and of other and similar iron structures, which formed such an important feature in railway construction and harbour improvements, were followed to a considerable extent by several engineering firms in this district, allusion being more particularly made to those noble bridges crossing the Tyne and Wear.

AIR-ENGINES—ALARMING WASTE OF COAL.—Mr. JAMESON read a paper on "Air Engines and an Air Compressing Apparatus," in which he pointed out that, in the steam-engine not more than one-seventh of the total consumption of heat was utilised, and then proceeded to enumerate the causes of the non-success of the air-engines which have hitherto appeared, referring to two as types of the whole. In the first he showed that, in addition to the heat required to work the engine, there was a consumption of heat in the hot chambers of the generators resulting only in the development of heat in the cold chamber, which actually resisted the action of the engine; that this absorption and development of heat acted in three ways—first, in absorption by diminishing the working pressure; next, in its development increasing the resistance; and, thirdly, in interfering with the action of the respirator. He also stated that the necessity existing for keeping all parts of the machine at once in motion resulted in a loss of effect, represented by 2 to 4 cubic feet for every foot of air contained in the working cylinder at the best point of its stroke, and he said that the operation of these causes necessitated the employment of excessive heat, or very slow speed—an almost fatal alternative. The second type of an engine, he said, required the employment of extremely large apparatus, because there was a pressure diagram, and a resistance diagram, caused by the working of a pump, and the total diagram must, therefore, amount to three times the effective diagram. In the air-compressing apparatus described, the effects he referred to are obviated by the fact that there is no transference of heat from the hot to the cold chambers, but that the total heat absorbed in the hot chamber was converted into mechanical effect, and therefore a lower degree of heat might be employed. That there is no difficulty in the arrangement from cushioning in the working cylinder; that the highest point of pressure obtained in the generator is not again lost, as it is in all other cases, and that, in addition to the improvements effected on the first type of engine he described, the new apparatus is capable of receiving the whole effect obtainable by the use of the second form of apparatus, and without its resistance, and at high instead of at low pressures. He finally referred to the advantages to be derived from the use of air instead of steam, which he stated to be a saving of fuel, freedom from risk of explosion, bursting under air pressure being comparatively harmless if it should occur; but he stated that no safety-valves were required in the apparatus described by him, as it was self-governing in the production of pressure. It was not liable to derangement—would work reversed as well as forward. Insurance was not affected by the use of the engine, and the compressed air might be applied in any situation, being laid on like gas, to be used when and how it was required. He stated that power might be supplied in this way to a whole town, at a cost infinitely less than the cost of the present method, and with other advantages which required no comment.—Papers "On the Working Railways by Stationary Engines," by Mr. J. F. SPENCER; "On a New Plan for Hanging Dock Gates," by Mr. R. A. PEACOCK, were also read.

GUN COTTON, AND ITS ADVANTAGES.—An interesting discussion followed the reading of the joint committee's report on Austrian gun cotton.—Sir W. G. ARMSTRONG, the President of the Association, said it was impossible to listen to the report which had been read without being very much impressed with the great promise there was of gun-cotton becoming a substitute for gunpowder; but, at the same time, there were certain peculiar anomalies about it, which he certainly should like to have cleared up, and until they were, they could not feel that perfect confidence in the results that they wished to do. He did not understand how the recoil could be so small, and the gun was not heated by the use of gun-cotton, as in the case of gunpowder. The report stated that the use of gun-cotton enabled them to reduce the length of the gun. It was quite certain, however, that with a short gun they could not get an equal velocity upon the initial velocity as upon a long gun.—Admiral BELCHER thought that the reason the gun was not heated by an explosion of gun-cotton might be because the gases had not time to heat the gun, owing to the rapidity of the explosion, which was slower in the case of gunpowder.—Sir W. G. ARMSTRONG: But we are speaking of where the velocity is equal in both cases.—Admiral Sir EDWARD BELCHER suggested that the heating might arise from the greater amount of fouling in the case of gunpowder.—Capt. MAURY, late of the United States Navy, said that the report was something more than interesting, because it was so exceedingly suggestive; and it appeared to him that it afforded to them an element of security by giving the preponderence on the side of defence, with which the whole mind of the whole world had lately been occupied. He then proceeded to speak of the difficulty of having magazines of gunpowder under water, and said that he thought gun-cotton, being very light, could be used for blowing up ships, and also for protecting places on the banks of rivers, by having magazines of it under the surface of the water. Last week they had the intelligence of a vessel having had a mine exploded under her on the James river. That magazine contained several thousands of pounds of powder. The crew did not know that the mine was there; but it did not destroy the vessel. It merely threw up a column of water, which washed some of the men overboard, but it did not destroy her. His own conclusion was that to make sure of destroying a vessel after she had passed the forts they must mine the channel away in such a manner that she must come in contact with one or other of the mines. It was found that wooden vessels to contain the gunpowder would not do, and the use of gunpowder in iron vessels also presented very great difficulties. But since gun-cotton had the remarkable effect of destroying a vessel—he did not know her strength—at a distance of 18 feet, and that not vertically but laterally, the question came up whether they might not fortify and protect those channel ways by placing a ring of magazines along the bottom; but at any rate, if that was not necessary, they could float them at any depth, and out of the reach of the vessels generally using the channel. That appeared to him to be one of the most important uses of gun-cotton, and it was one which would give safety to cities which were some distance from the mouths of navigable rivers.—Admiral Sir EDWARD BELCHER stated that the explosion of powder under water was once done under one of his vessels. The object of it was to blow away the ice from the bows of the *Pioneer*, so as to get her free from it. He tried various plans, and found that when the explosion took place under the ice, when there was no *point d'appui*, as it were, on which to place the powder, it failed in the desired effect. He accordingly placed it upon the ground, thinking that its explosion would blow the ice clear of her bows without touching the vessel. There was sufficient water to form a cushion, and when the explosion took place it produced a great wave, upon which the vessel rose, and so great was the shock that the copper vane of the mainmast head was bent 45° over the mainmast head.—Mr. J. SCOTT RUSSELL, after alluding to the immense explosive qualities of gun-cotton, said that, as Sir William Armstrong had argued, it was mathematically impossible that the gases of gun-cotton could produce half the power of gunpowder, and yet they did. He had got a little glimpse of daylight upon it, which he would give to them if they liked. Steam was a gas, and steam expanded just by the same laws as other gases did. A great deal of the gas of gun-cotton happened to be steam. Let them conceive 100 lbs. of gun-cotton shut up in a chamber that just held it. They had got there all the gases that had been spoken of, but they had also got 25 lbs. of solid water—about one-third of a cubic foot of water in that chamber. What did they do with it? They put fuel, they put fire to it. They heated the whole remaining pounds of patent fuel. If, then, they considered the gun-cotton gun as the steam-gun they got rid of two difficulties. They would have first the enormous elasticity of steam; and, second, they would get the coolness of it. They all knew that if they put their hand to exploded high-pressure steam it had swallowed up all the heat, and came out quite cool. He believed that the gun-cotton gun was neither more nor less than Perkins's old steam-gun, with only this difference, that you bottled up the fuel and water, and let them fight it out with each other. They did their work, and came out quite cool. He hoped, however, that it was understood that he did not dogmatise. He put all he had said with a note of interrogation upon it. The report stated that 100 lbs. of gun-cotton produced, when exploded, 955 cubic feet of gas, while the same weight of gunpowder produced 308 ft. of gas when exploded. As regarded bulk, 22 lbs. of gun-cotton go into 1 cubic foot, while from 56 lbs. to 60 lbs. of gunpowder go into 1 cubic foot. The quantity of gas in 100 lbs. of gun-cotton, when raised to the boiling point, was 1715 cubic feet. Supposing that these 1715 cubic feet of gases, produced by 100 lbs. of gun-cotton in a space of 4 cubic feet, be compressed into their original bulk, they would give a pressure of 429 atmospheres if the boiling point were maintained. If 421 cubic feet of gases, produced by 100 lbs. of gunpowder in a space of 0·981 ft., it would give also 429 atmospheres at the boiling point. It resulted from this that 429 atmospheres were obtained from the gun-cotton, and 421 from the gunpowder, so that really the same quantity of gases and the same number of atmospheres appeared to be produced from both, though not from equal weights of both, because the unit of gun-cotton was one-third of the weight of gunpowder, which were taken as equivalents for comparison. The great waste of force in gunpowder constituted an important difference between it and the gun-cotton, in which there was no waste. Gunpowder consisted of about 68 per cent. solid matter and 32 per cent. useful gases; and it were the useful gases of gun-cotton only which they had been comparing with the useful gases of gunpowder. It might be said, therefore, that one-third of the gunpowder was not directly useful in producing gases; but the 68 per cent. of solid matter in gunpowder was not only waste itself, but it used up a large portion of the mechanical force in the remaining 32 per cent. of useful gases. General Lenk has found by actual experiments that the proportion of 11 lbs. of gun-cotton, occupying 1 cubic foot of space, produces a greater force than gunpowder, and a force of the nature required for ordnary artillery. But each gun and each kind of projectile requires a certain density of cartridge. Practically, gun-cotton is most effective in guns when used as a quarter to a third weight of powder, and employing a space of one and one-tenth of the length of the powder cartridge. The mechanical structure of the cartridge is of high importance, as affecting its ignition. The cartridge is formed of a mechanical arrangement of spun cords, and the distribution of these, the place and manner of ignition, the form and proportion of the cartridge, all affect the time of complete ignition. The temperature of ignition of gun-cotton is between 136° and 170° Celsuis, or between 277° and 338° of Fahrenheit, a temperature sufficiently high to ensure safety for all practical purposes. Its cost of production is considerably less than that of gunpowder, the price of quantities being compared which will produce equal effects. The report then proceeded to give the principles which govern the practical applications of gun-cotton. As showing its practical application to destructive purposes, it was stated that from a difference in the law of expansion, arising, probably, from the presence of water in intensely heated steam, there is an extraordinary difference of result—that the same shell is exploded by the same volume of gas into more than double the number of pieces. This is to be accounted for by the greater velocity of explosion when the gun-cotton is confined very closely in very small spaces. It is also a peculiarity that the stronger and the thicker the shell, the smaller and more numerous the fragments into which it is broken. The fact that the action of gun-cotton is violent and rapid in exact proportion to the resistance it encounters, tells us the secret of the far higher efficiency of gun-cotton in mining than gunpowder. The stronger the rock the less gun-cotton, comparatively with gunpowder, is found necessary for the effect—so much so, that while gun-cotton is stronger than gunpowder, weight for weight, as 3 to 1 in artillery, it is stronger in the proportion of 6274 to 1 in strong and solid rock, weight for weight. It is the hollow rope form which is used for blasting. Its power in splitting up the material is regulated exactly as you wish. It is a well-known fact that a bag of gunpowder nailed on the gates of a city will blow them open. A bag of gun-cotton exploded in the same way produces no effect. To blow up the gates of a city with gun-cotton it must be confined before explosion: 20 lbs. of gun-cotton, carried in the hand of a single man, would be sufficient, only he must know its nature. In a bag it is harmless, exploded in a box it will shatter the gate to atoms. In the course of the discussion which followed, Professor Abel read a report, giving a description of the Austrian system of manufacture of gun-cotton, and gave it as his opinion that, under a properly regulated system, the production of gun-cotton was not more difficult and complicated, and was attended with considerably less risk of accident to the workmen and the manufacturing establishment, than the production of gunpowder.—Captain GALTON said the subject reported upon was exceedingly important, and it must be borne in mind, in connection with this matter, that the Austrians had within a recent period discontinued the use of this material for guns. He begged to suggest that a proposal be submitted to the committee on recommendations to the effect that the committee be requested to continue their labours in this enquiry.—Professor MILLER said they were under great obligations to the Austrian Government for the assistance they had given to the committee in this enquiry. Their thanks were also due to Professor Abel for his careful experiments, and the lucid manner in which he had detailed those experiments.

THE CAUSE OF BOILER EXPLOSIONS.—A paper on this important subject was contributed by Prof. G. B. AIRY, the Astronomer Royal. In considering the cause of the extensive mischief done by the bursting of a high-pressure steam-boiler, it is evident that the small quantity of steam contained in the steam chamber has very little to do with it. That steam may immediately produce the rupture, but as soon as the rupture is made, and some steam escapes, the pressure on the water is diminished, a portion of the water is immediately converted into steam at a slightly lower temperature and lower pressure; and this in the same way is followed by other steam of still lower temperature and pressure, and so on, till the temperature is reduced to 212° Fahr., and the pressure to 0. Then there remains in the boiler a portion of the water at the boiling point, the other portion having gone off in the shape of steam of considerably diminishing pressure. From this it is evident that the destructive energy of the steam, when a certain pressure is shown by the steam-gauge, is proportional to the quantity of water in the boiler. By the assistance of Prof. Miller, of Cambridge, Messrs. Ransome, of Ipswich, and George Biddell, he had been able to obtain a result which he believed to be worthy of every confidence. He would first state as the immediate result of Mr. Biddell's experiments, that when there were in the boiler of a small locomotive 22 cubic feet of water, at a pressure of 60 lbs. per square inch, and the fire was raked out, and the steam was allowed gently to escape with perfect security against priming, the quantity of water which passed off before the pressure was reduced to 0, was 2¾ cubic feet, or ⅛ of the whole. In regard to the use made of Prof. Miller's theory, Prof. Miller had succeeded in obtaining a numerical expression of the pressure of the steam at twelve different measures of the volume occupied by water and steam, which expression he had succeeded in integrating accurately, and he had thus obtained an accurate numerical expression of the destructive energy of the steam. In regard to the use of General Didion's experiments, these experiments give the velocity of the ball, in cannon of different sizes, produced by different charges of powder. He had found by trial which of these experiments exhibit the greatest energy per kilogramme of powder, and had adopted it in the comparison. The result was as follows:—The destructive energy of 1 cubic foot of water, at 60 lbs. pressure per square inch, is equal to the destructive energy of two English pounds of gunpowder in General Didion's cannon experiments. General Didion's experiments were made with smooth-bored cannon. It cannot be doubted that much energy is lost in the windage; some also from the circumstance that the propelling power ceases at the muzzle of the gun before all the energy is expended, and some from the coolness of the metal. If we suppose that, from all causes, one-half of the energy is lost, then we have this simple result. The gauge pressure being 60 lbs. per square inch, 1 cubic foot of water is as destructive as 1 lb. of gunpowder. In one of Mr. Biddell's experiments, the steam-valve was opened rather suddenly, and the steam escaped instantly, with a report like that of a very heavy piece of ordnance. This is not to be wondered at, for it appears from the comparison above that the effect was the same as that of firing a cannon whose charge is 44 lbs. of powder.—Mr. WM. FAIRBAIRN, F.R.S., said he himself had paid considerable attention to the subject of boiler explosions, and he was glad to find that Prof. Airey had drawn attention to it. It was a most important subject, as about 150 persons were killed annually by boiler explosions. That was the reason they had formed an association in Manchester for the purpose of preventing boiler explosions. It had now been in operation for about eight years, and he believed there had only been one or two lives lost during that time by the explosion of boilers under the inspection of this association; whereas in other parts, not under the inspection of the association, there had been two or three explosions lately. This association has done a large amount of good by preventing accidents of this kind; and he would earnestly recommend the establishment, in a district like that around Newcastle, where they had so many boilers in operation, of a similar association. He merely mentioned those facts to show that people having boilers should associate themselves for the purpose of preventing explosions, otherwise the Legislature might interfere to establish a system of inspection not so pleasant to those having boilers under their charge.

THE CANONBIE COAL FIELD.—A very pleasant geological excursion to the Canonbie district was made by a number of members interested in the section. Amongst the company were Mr. Hugh Taylor, Prof. Jukes, Prof. Rankine, Prof. Morris, Prof. J. H. M'Chesney, American Consul; Mr. Warington Smyth, and Mr. L. Brough. At Riccarton the business of the geologists commenced, and in the charge of Mr. J. F. Tone, the chief engineer of the line, the party were taken first to Whitrope Tunnel, about two miles north from the station. Mr. Tone produced a section showing the junction of the Lower Carboniferous, Old Red Sandstone, and Silurian formations, and at a place called Palmer's Hill, pointed out where these formations are intersected by a dyke of greenstone, or basaltic rock. A deep cutting, about a mile in length, and 70 feet in depth, through alternate beds of limestone, shale, and ironstone of the lower carboniferous formation was inspected, as was also the cutting through the lower carboniferous formation at the southern entrance to the tunnel. The tunnel passes through the Lower Carboniferous and Old Red Sandstone, and impinges upon the Silurian. At the northern end they inspected a deep cutting through the conglomerates of the Old Red Sandstone. This done, the train returned to Riccarton, and steamed thence to Canonbie, which is destined to be most famous for its coal mines. The Eskdale and Liddesdale coal fields belong geologically, like North Northumberland, to the lowest and oldest divisions of the carboniferous system—the mountain limestone—the borders of the tract occupied by which may be roughly indicated by a line drawn south-east from Canonbie, to Brampton, thence east to Acomb-on-Tyne, thence north-east to Ainmouth, thence along the coast to Berwick, and thence south-west across Berwickshire, to about two miles above Kelso, encircling the porphyry district of the eastern half of the Cheviot range, which extends from about Wark and Carham to the source of the Reed. The inclination of the strata is varied, the angle depending chiefly on their relation to the porphyry, from which they generally dip, yet modified in many places by basaltic dykes and outbursts, in the neigbourhood of which the beds are broken and contorted. In the western part of Roxburghshire it forms the basin of the Liddell and its tributaries, stretching as far north as Hindhaugh and the Maiden Paps, and along the south-east border to a point beyond the Carter Bar; but this is merely an outlying, or rather connecting portion of the field, which has its proper development in Northumberland, Cumberland, and Dumfriesshire, and the seams are either unworkable or thin and poor in quality. Much good money has been wasted in fruitless sinking for coal both in Liddesdale and Teviotdale. That part of the field which lies in the county of Dumfries is estimated to contain a workable area of 45,000 acres, and the number of workable seams is ten in all, of the mean aggregate thickness of 55 ft., the thickest seam being 9 ft. thick. The Canonbie and Tynehead, or Plashetts, coals are of two different classes, generally recognised as steam and house coals, but both of excellent quality. For steam purposes, the large open burning Canonbie coals are preferable to the Tynehead coals; whilst the latter are said to surpass the Welch house coals, and make first-rate coke for locomotives. Numerous outcroppings in the intervening country show the continuity of the strata available for coming generations. The colliery at Canonbie has two shafts.—the A, or engine pit, which is about 80 fms. deep, and the B, gig, or working pit, 122 yards off the other, and sunk to 57 fms. in Oct. last. The seams are five in number—the main seam, 6 ft. thick, at 40 fms. from the surface of the engine pit; the Nine-feet seam, at 58 fms.; the Five-feet seam, at 68 fms.; the Black Top, 5 ft. thick, at 78 fms.; and the Seven-feet seam, at 80 fms. The dip of the seam is one in four. The principle on which the works were conducted from the earliest period till the year 1859 was the unvarying principle of the pillars being formed about 30 yards in length, and 7 or 8 yards in breadth, the working places being 4 or 5 yards wide, and the cross holings 6 or 8 ft., which plan enabled the pillars eventually to be worked entirely away. About four years ago this system was abandoned, and the plan substituted of having the pillars 12 yards square, with all the workings round about from 9 to 10 ft. wide. Both plans are disapproved by the best authorities, as, taking into account the very limited extent of the workable field of coal between the New Red Sandstone and the mountain limestone, it is of the greatest consequence to conduct the workings upon the most practical principle of obtaining all the coal, and this principle is indisputably as follows:—Either to adopt the principle of long wall, by taking away all the coal, and supporting the roof and tramroads by buildings of wood or stone, or to lay out the works upon a sound principle of "stoop and room," such being the all but universal style adopted in the deep collieries near Newcastle. By the latter system the pillars are left so large as to withstand all pressure that can come upon them, until in due time they are worked away by what are termed "lifts." In July, 1859, the yield of the pit was 80 tons per day, in equal quantities from the Five and Seven-feet seams. In October, 1862, it was 150 tons per day, from the Black Top and Five-feet seams. The price of Canonbie screened coal at the latter date was at Carlisle, 8s. 3d. per ton, including 2s. for carriage, and 11d. agents' commission; and at Hawick, 10s. 11d., including 4s. 3d. carriage, and 1s. 3d. commission. Lime and freestone, white and red, of excellent quality, abound near Canonbie and Langholm, as also in Liddesdale; and in the upper part of Eskdale there is a great deal of ironstone, besides lead, copper, antimony, manganese, &c. Chalybeate springs are frequent both here and in Liddesdale.

TREATMENT OF POOR COPPER ORES.—The Jarrow Chemical Works formed one of the interesting objects of the excursions, and the solid caustic soda attracted particular attention. The process of obtaining the sulphuric acid from pyrites, sulphate of soda, &c., having been examined, the company proceeded to view the copper smelting works belonging to the same company, at Willington, on the north side of the Tyne. This establishment is especially interesting, from the fact that it may turn out to be but the nucleus of a new and important branch of industry on the Tyne, it being regarded as a sort of necessary complement to the already vast chemical interest. From the experiment at Willington, it would seem that the production of soda, carbonate of soda, and Epsom salts, for which the Tyne has long been famous, is destined, henceforth, to go hand in hand with the production of copper. At Willington the copper is made not from the original ore, but from the refuse left after the sulphuric acid has been extracted. The residue of brown cinders, as drawn from the sulphuric acid burners, is brought to Willington, and then "roasted" in a series of furnaces, a quantity of "slag" being skimmed off at each roasting, and the product coming out after each ordeal in a state of greater purity. After the first burning, a black mass is taken from the furnace containing only about 15 per cent. of copper. This is broken up and skimmed, and it then contains 50 per cent. of copper. Other two courses of fire bring it to 70 per cent. and 80 per cent. respectively. In the last-mentioned stage the black coal-like product is mixed with fine filaments of copper. The next step reduces it to what is called "blister copper," in which state it is approaching purity, being of the colour of copper, of a porous and spongy structure, and containing 95 per cent. of the metal. It is again melted and subjected to a process somewat similar to puddling, and is then cast into ingots and cakes or "tiles," the finished article of commerce. It is not quite so pure as that manufactured from the ore, its value being about 98½ per cent. of copper. At present about 10 tons per week are produced at these works.

ALUMINIUM BRONZE.—The important part which the new metal, aluminium, appears destined to play in the arts, chiefly as an alloy, induces me to direct the attention of our readers to the peculiarities of aluminium bronze, which, if considered both in respect of its characteristics and its market value, will be esteemed by manufacturers as virtually a new metal. When the French chemist, M. Deville, published, in 1854, an account of his experiments upon the preparation and properties of aluminium, great hopes were entertained that it might be produced at a sufficiently low price to admit of its receiving many practical applications, to which it seemed suitable on account of its remarkable qualities. A metal, being but little more than one-third of the specific weight of copper, and considerably less than half that of the lightest of the commercial metals, zinc; unacted on by oxygen or sulphur, and but little affected by most acids; possessing at the same time tenacity, combined with ductility, and having a moderately high melting point, might well be supposed, *a priori*, to be susceptible of many interesting and very important uses. Up to the present time, however, these expectations concerning aluminium have not been realised. Although it is now produced on a considerable scale, the price remains too high* to permit of its being put to many uses to which it might be applied if it were a cheap metal; and its peculiarly dull colour is an impediment to its employment where beauty and brilliancy of appearance are desirable. Independently, however, of its usefulness *per se*, there seems to be a wide field open for the application of aluminium in the form of alloys with the more ordinary metals, the properties of which are changed in a remarkable manner by its presence, even in small quantities. On the other hand, very small quantities of the common metals destroy the ductility and malleability of aluminium itself—in some cases altering its colour, and, in others, rendering it as brittle as glass: mixed, however, with a certain proportion of copper, an alloy is produced which possesses the properties of a valuable metal, capable of applications not only very important in themselves, but for which it seems difficult to find any other metal or metallic alloy equally suitable. This mixture of aluminium and copper is the alloy called aluminium bronze. The alloy seems to have been first made a few years ago by Dr. Percy. Many of our readers will remember the specimens which were placed in the International Exhibition by Messrs. Bell, of Newcastle; and a later exhibition of articles manufactured from this substance by Messrs. Mappin, of Regent-street, must have familiarised most persons with its fine general appearance. Beauty of external appearance, however, is but one quality of a metal, and although an all-important one in certain respects, it is one without which, as in the instance of iron, the metal may possess the most valuable and interesting properties. Without beauty of surface, it is true that its applications must be limited to the useful; but in England, where the employment of metallic substances is so varied and so extensive, mere beauty is a secondary consideration. In the case of aluminium bronze, however, beauty of exterior and more sterling qualities are united. In colour this alloy resembles gold so closely that it would be difficult by mere inspection to distinguish one from the other; but its mechanical qualities excel those of gold. It is composed of copper and about 10 per cent. of aluminium melted together, and re-melted once or twice. It is stated that the most essential condition to success in producing the alloy is purity in the copper employed; the best copper for the purpose, although its price prevents it from being much used, being that deposited by galvanic action: the next best is that from Lake Superior, which is very pure, and yields, with aluminium, a very good alloy. The re-melting of the alloy is a matter of great importance. The first melting appears to produce intimate mechanical mixture, rather than chemical combination of the metals; as in the proportion of 10 of aluminium and 90 of copper, an alloy of a very brittle character is produced by the first melting; but renewed opportunity of uniting into a definite chemical compound being afforded by repeated melting, a more uniform combination seems to take place, and a metal is produced free from brittleness, and having about the same degree of hardness as

* The present price in London is about 5s. per oz.

iron. The alloy containing rather less than 10 per cent. of aluminium, is said to possess the most uniform composition and the best degree of hardness; but it is not always an easy thing to produce this desirably uniformity of texture, as patches of extreme hardness sometimes occur, which resist the tools, and are altogether unamenable to the action of the rollers. The alloy produced by this combination of copper and aluminium is very tenacious, malleable, rigid, light in weight, and possesses a fine golden colour. Its qualities being so various, we have to view it in two different characters—as suitable to the manufacture of ornamental articles, to which it is adapted from the closeness of its resemblance to gold; and as capable of being applied, on account of its valuable mechanical properties, to useful purposes, to many of which it seems to be better fitted than any other metal or alloy. With regard to the first, but what is really, after all, the least important of its characters—that is, its adaptability to ornamental uses—the points to be considered are colour, condition of surface, capability of receiving impressions from dies, or being worked and chased; and, lastly, unsusceptibility to the action of oxygen and sulphur. What is the situation of aluminium bronze with reference to these questions? In its application to ornamental purposes, this alloy is, undoubtedly, a valuable addition to the resources of the artist, inasmuch as it affords him the means of imitating almost exactly the effect of gold, in a material very superior to the ordinary gold substitutes, homogeneous in texture and colour, and comporting itself, with respect to external influences, more like silver than like a cheap alloy. In sculptured and chased work, it presents a similar depth and richness of effect with gold, and in polished surfaces it is almost equally brilliant; whilst, in cases where it is thought that the colour of the alloy does not afford a sufficiently close approach to the tint of pure yellow gold, it will probably, as a gilding metal, present the best possible foundation for a coating of fine gold. In many respects, therefore, the new alloy may be reasonably expected to play an important part in relation to ornamental work. It remains to examine its qualities with regard to important mechanical applications, and it is here that the valuable qualities of the alloy come out in the strongest manner. In respect to this part of the subject, the properties of the metal to be considered are its tenacity, malleability, power of resisting compression, rigidity, founding qualities, behaviour under the action of tools, and specific weight. With regard to most of these points, the aluminium alloy compares with great advantage with all other metals and alloys. In experiments made in the Royal Gun Factory at Woolwich, by Mr. Anderson, upon the tensile strength of this metal, he found it to exceed that of the best gun metal in the ratio of 2 to 1; the aluminium bronze sustaining a strain of 73,185 lbs. to the square inch, the gun metal not more than 35,040 lbs.; whilst the tensile strength of the best cast-steel is about 72,000 lbs. So with regard to the power of resisting compression, it was found that a specimen of the alloy bore a crushing force of 130,000 lbs. per square inch, whilst there were no indications of compression until 20,384 lbs. per square inch had been applied; the strength of the alloy under compression exceeding that of the best cast-iron, which may be taken at less than 120,000 lbs. The superiority of the metal extends likewise to the question of transverse strength or rigidity, wherein it surpasses gun metal in the ratio of 3 to 1, and brass in the ratio of 44 to 1. As a founding metal it can be employed without difficulty, and it produces castings, of any size, of the best character; whilst under the file, and in the lathe, it can be worked almost as easily and freely as gun metal. Although it can be rolled into sheets, it is said that it does not solder very readily nor strongly, and this might, perhaps, prove some impediment to its use in producing certain forms of work. But in every other respect ordinary mechanical manipulation can be applied to it with the greatest success. There is an important quality of the alloy not yet mentioned—that is, its low specific gravity. The weight of the bronze containing 10 per cent. of aluminium, is 7·68, a weight which corresponds very nearly with that of wrought-iron; so that, taking into consideration the superior strength of the material, and the consequent smallness of parts necessary in an apparatus constructed from it, we perceive that, from the lowness of its specific gravity, the work would be extraordinarily light. Although, in a mechanical sense, this alloy seems to compare most closely with steel; and it is the opinion of competent persons that in certain kind of apparatus and instruments, the oxidisable steel may be well substituted by the comparatively unoxidisable aluminium alloy. It is probable in the construction of high-class philosophical apparatus, therefore, that the great value of this alloy will be found. In such work combined strength and lightness are requisite, and these qualities are united in the highest degree in aluminium bronze. It can be engraved with great sharpness and regularity, and the engraved lines are said to be remarkably distinct. Writing on this subject, Lieut.-Col. Strange observes that experiments, and the concurrent testimony of those who have given it a fair trial, prove that 10 per cent. aluminium bronze is superior, not in one or some, but in every respect, to any metal hitherto used for the construction of philosophical apparatus. The present price, about 6s. 6d. per lb., of the alloy, is, no doubt, an obstacle to its exteuded use. In cases where elaborate workmanship is required, the price will, however, bear but a small proportion to the value of the work; and the important question, under such circumstances, is not the difference of a few shillings in the value ofthe raw material, but the existence of qualities in that material which will ensure the greatest possible effectiveness in the manufactured article.—*Newton's London Journal of Arts and Sciences.*

COATBRIDGE: STRANGE PRODUCTION FROM A BLAST-FURNACE.—I send the following note cut from the *Glasgow Herald*, July 28, in the hope of eliciting an explanation of the phenomenon:—"Yesterday afternoon, while the workmen at one of the blast-furnaces, Dundyvan Ironworks, were busy working it with the bars, the blast broke out by the back 'tuyere,' when it belched forth a quantity of red-hot ashes and scoria, followed by another product of rather a peculiar appearance, in the shape of a shower of white flakes, like cotton, which continued for several minutes, until not only the ground around the furnace was covered, but also the workmen, who, while stopping up the orifice, appeared to have been engaged in a cotton factory or exposed to a snow-storm. The seeming flakes of cotton were wafted about by the wind, but a few handfulls were collected for curiosity. It has the appearance, and to the touch feels, like very fine wool, mixed with hair, and is imflammable. What it is, or how it was manufactured in the interior of a red-hot furnace, is a query that we cannot solve; but we understand that something of a similar production was seen at one or other of the ironworks some years ago. I send you a specimen of this wonderful cotton, or product of the refuse of iron, for the curiosity of the thing."—J. D. CAMPBELL.

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LONDON: Printed by RICHARD MIDDLETON, and published by HENRY ENGLISH, the proprietors), at their office, 26, FLEET-STREET, where all communications are requested to be addressed. [*Sept. 5, 1863.*